E. Sominska, S. Ramesh, Yu. Koltypin, Z. Zhong, H. Minti, R. Reisfeld and A. Gedanken, J. Phys. Chem. B, Vol 103 (17) pp 3361-3365).

Yet another object of the present invention is to disperse the rare-earth coated silica nanoparticles in sol under sonication containing germanium tetraethoxide and aluminium salt.

Still another object of the present invention is to control the viscosity of the sol and apply a sol-gel thin film inside high purity silica glass tube by the dip coating technique.

Yet another object of the present invention is to optimize the lifting speed for controlling the thickness of the coating to maintain the desired clad-core dimensions in the preform.

Still another object of the present invention is to control the viscosity of the sol, pH and the lifting speed to obtain homogeneous and uniform coating along the length of the tube.

Yet another object of the present invention is to optimize the loading percentage of the nanoparticles and other codopants in the sol.

Still another object of the present invention is to reduce the possibility of change in composition of the particulate core layer due to evaporation of the RE salt during drying and sintering .

Yet another object of the present invention is to produce preforms with desired RE concentration in the core and good homogeneity along the length of the preform.

Still another object of the present invention is to reduce the time period of processing the silica tube at high temperature for fabrication of RE doped preforms.

Yet another object of the present invention is to reduce the number of steps of the process to make the process more simple and economic.

Still another object of the present invention is to process the tube at ambient temperature before sintering and collapsing instead of high temperature involved in the CVD process to make it more simple and economic.

Yet another object of the present invention is to reduce the requirement of precision equipments for fabrication and consequently reduce the capital investment and cost of the product.

Still another object of the present invention is to provide a process where the numerical aperture of the fibre is varied from 0.10 to 0.30 maintaining RE concentration in the core between 50 to 5000 ppm along to produce fibres suitable for application as amplifiers, fibre lasers and sensors for different purposes.

Yet another object of the present invention is to make the process less sensitive to the process parameters and consequently make it more reliable and economic.

Summary of the invention

The novelty of the present invention lies in eliminating the step of the formation of porous soot layer at high temperature (1000°C or above) by CVD process inside a fused silica glass tube for formation of the core. Instead a thin silica gel coating containing other dopants in desired proportions is applied through a silica sol at ambient temperature. The above method ensures a better control of the characteristics of the coated layer and uniformity along the length of the tube. The inventive step further includes elimination of the step of the incorporation of the rare-earth ions into the porous soot layer following the solution-doping technique. The rare-earth oxide coated silica nanoparticles are dispersed at ambient temperature in the silica sol mentioned above under sonication thereby further eliminating the formation of microcrystallites and clusters of rare-earth ions. The elimination of the possibility of evaporation of RE salts at high temperatures due to the direct addition of RE oxides is another inventive step of the process which prevents change in composition including variation of RE concentration in the core and also reduces the possibility of formation of RE dip at the core centre. The RE incorporation effficiency is much higher than the conventional processes. The process thus ensures better control of RE concentration in the doped region and homogeneous distribution of RE ions along the radial direction as well as the longitudinal direction. As a result the reproducibilty and reliability of the process increase to a great extent. The addition of $Ge(OET)_4$ at ambient temperature in the silica sol above reduces the quantity of $GeCl_4$ which is required at high temperature to achieve the desired NA. All the steps combined make the process simple and more economic than the conventional processes.

Detailed Description of the Invention

Accordingly, the present invention provides a process of making rare earth doped optical fibre which comprises (a) obtaining rare earth oxide coated (Eu_2O_3, Nd_2O_3, Tb_2O_3, Er_2O_3 etc.) silica nanoparticles by sonochemical method, (b) preparation of stable dispersions of the above RE containing powders in the desired proportion in presence of suitable dopants like Al_2O_3, GeO_2 etc. in a silica sol of $Si(OC_2H_5)_4$ under sonication, (c) applying a thin coating of the silica sol on the inner surface of high purity clear fused silica glass tubes by sol-gel dip coating technique, (d) drying the coated layer in air at 70 to 150°C, (e) mounting the tube on glass working lathe for processing by MCVD technique, (f) dehydrating the coated layer inside the tube at a temperature in the range of 800-1200 °C in presence of excess Cl_2, (g) sintering the coated layer in presence of a mixture of oxygen and helium in the temperature range of 1400 to 1800°C for formation of the core, (h) collapsing the tube by usual method at a temperature in the range of 2000-2300 °C to obtain a preform, (i) overcladding the preform with silica tube and (j) drawing fibres of standard dimensions from the preform by the conventional methods.

In an embodiment of the present invention, the RE oxide is selected from Eu_2O_3, Nd_2O_3, Tb_2O_3 and Er_2O_3 for preparation of the silica nanoparticles.

In another embodiment of the present invention, P_2O_5 and F doped synthetic cladding is deposited within a silica glass substrate tube prior to development of the coating by known method like Modified Chemical Vapour Deposition (MCVD) process to obtain matched or depressed clad type structure in the preform.

In a further embodiment of the present invention, particle size of the RE coated SiO_2 powders ranges from 50 to 200 nm.

In still another embodiment of the present invention, the composition in oxide mol% of $SiO_2 : RE_2O_3$ in RE_2O_3 coated SiO_2 powders varies from 99.5 : 0.5 to 95 : 5.

In yet another embodiment of the present invention, the equivalent oxide mol% of SiO_2 in the dispersion varies from 98.5 to 90.5.

In still another embodiment of the present invention, a silica sol prepared with $Si(OC_2H_5)_4$ was used as the diluent of the RE_2O_3 coated silica powder.